

The Suppression of Autotomy in *Linckia multifora* (LAMARCK) by a Parasitic Gastropod, *Stylifer linckiae* SARASIN

BY

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(Plate 48; 1 Map)

INTRODUCTION

HOST-PARASITE RELATIONSHIPS in which the parasite in some way interferes with the normal growth processes of the host have been known for many years. Indeed, aside from those reports concerning the more obvious pathological or lethal manifestations of parasitism, much of the literature related to the responses of host organisms has been devoted to this topic. As examples of this sort of host-parasite interaction might be mentioned such diverse phenomena as the stunting or retardation of growth and development seen in many organisms, including man, when infected by any one of a wide variety of parasites (summarized by VON BRAND, 1952); parasitic castration and inhibition of molting in crustaceans infected with rhizocephalans or epicarideans (reviewed by REINHARD, 1956); gigantism in snails harboring trematode larvae (ROTHSCHILD & ROTHSCHILD, 1939; PAN, 1962); the accelerated pupation of insect larvae infected with parasitic insects (reviewed by VARLEY & BUTLER, 1933); and the enhanced growth (as increase in weight) of laboratory mice experimentally infected with the pleurocercoid larvae of a cestode (MUELLER, 1963).

The present report deals with the occurrence of a similar phenomenon in a sea star, *Linckia multifora*, when it is infected with *Stylifer linckiae*, a parasitic gastropod. More specifically, observations are reported which indicate that the tendency for "spontaneous" autotomy, normally quite high in *L. multifora*, is considerably reduced in parasitized rays, and it is suggested that this reduction is caused by the parasite.

MATERIALS AND METHODS

Specimens of *Linckia multifora* were collected in Kaneohe Bay, Oahu, Hawaii. In the laboratory, all animals were maintained in running sea water, in 35-gallon aquaria. In the earlier phases of this study wooden aquaria were used, but these were replaced by fiberglass aquaria during the experimental portion of the investigation.

In the initial observations both parasitized and normal animals were placed in the same aquaria, where they were maintained for periods of up to one month. All animals were examined at least once each day. Animals having autotomized one or more rays, the autotomized rays, and any animal appearing moribund³ were removed from the aquaria as soon as they were discovered. All autotomized rays were examined carefully for the presence of *Stylifer linckiae* at the time of their removal. Records were kept of the number of animals autotomizing one or more rays and of the number of parasitized rays autotomized.

Autotomy was induced experimentally by ligating rays near their base. Ligatures, for which either silk thread (Experiment I) or fine copper wire (Experiment II) was used, were applied to two rays on each animal. Thus, normal animals had two uninfected rays ligated, and parasitized animals had ligatures on either one uninfected and one infected ray, or on two infected rays. These animals were then placed in a fiberglass aquarium in

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³ The condition of *Linckia multifora* is readily determined by brief examination. If several patches are present on the rays adjacent to the ambulacra, where the epidermis has been lost and the underlying ossicles are plainly visible, it is usually an indication that the animal is in poor condition and will eventually disintegrate entirely.

running sea water and maintained without food for 10 days. During this time, periodic examinations were made, and the occurrence of autotomy in normal and in parasitized rays recorded. Autotomized rays were discarded as soon as they were detected.

RESULTS

A. Frequency of Infection and General Morphology of *Stylifer linckiae*

A total of 665 specimens of *Linckia multifora* was examined for the presence of *Stylifer linckiae*. Fifty-four of these animals, or 8.1%, were parasitized. Of these, 49 had one infected ray and 5 had two infected rays. Collections were made from two different locations, however, and the frequency of infection in these two populations of *L. multifora* differed considerably (Table 1).

Table 1

| Number of <i>Linckia multifora</i> infected by <i>Stylifer linckiae</i> according to Location of Collecting Site | | | |
|---|-----------------------------|-------------------------------|---------|
| Population Designation | Number of Animals Collected | Number of Animals Parasitized | Percent |
| B-8 | 525 | 53 | 10.1 |
| S. I. | 140 | 1 | 0.7 |

The locations of the collecting sites are shown on the map in Figure 1.

This difference, the cause of which is unknown, is mentioned primarily because all laboratory observations were made on animals from the population designated as B-8, and the higher frequency of infection in this population was used in the statistical analysis of the data.

The external appearance of *Linckia multifora* parasitized by *Stylifer linckiae* is shown in Plate 48, Figure 1. The snails are usually found in enlarged areas or "galls" on the adoral, lateral or aboral surface of the rays, where they occupy a position within the body wall but separated from the coelomic cavity by a layer of connective tissue (Plate 48, Figure 2). The capsule-like gall remains open to the exterior by means of a small pore which, according to HIRASE (1932), allows the snail to maintain a flow of water into and out of the gall for respiration and the removal of waste material. A single gall may contain from one to several snails (up to 5 in the present study). Internally, however, each individual snail is encapsulated by a separate connective tissue layer (Plate 48, Figure 3).

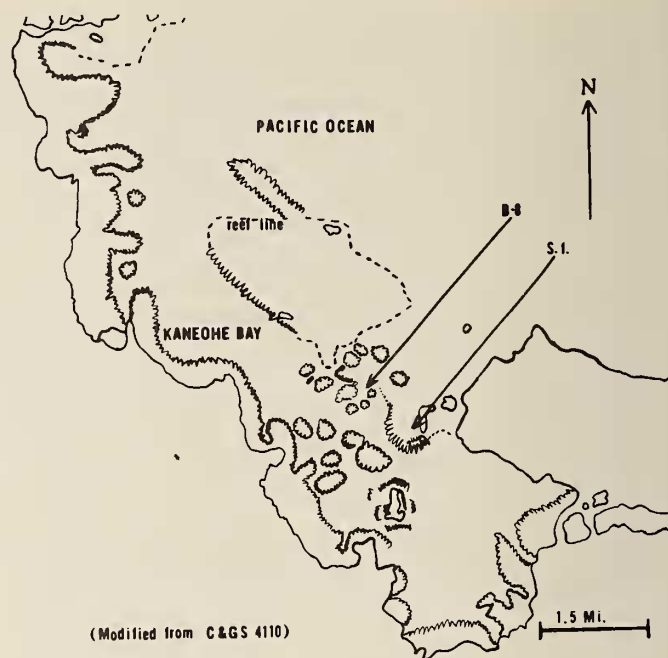


Figure 1
Map of Kaneohe Bay, Showing Location of *Linckia multifora* Collecting Sites

B. Frequency of Autotomy

The loss of rays in various species of Asteroidea by what has been termed "spontaneous" autotomy has been known for many years (HAECKEL, 1878; HIROTA, 1895; KELLOGG, 1904). Although the spontaneity of this process may be doubted, nothing is known of the actual stimuli involved in initiating this so-called spontaneous autotomy, nor is there any information available on the underlying physiological factors.

Autotomous loss of rays is quite prevalent in the family Linckiidae, although different species apparently vary somewhat in the extent to which it occurs. For example, EDMONDSON (1935) reported that 44.7% of the specimens of *Linckia multifora* collected by him showed signs of having autotomized at least one ray at some time in the past. Specimens of *L. guildingii*, however, were reported to show no indications of autotomy, although they were collected in the same area and at the same time as was *L. multifora*.

In the present study it was found that approximately 60% of the animals brought in from the field and maintained in wooden aquaria autotomized at least one ray (263 of 436). This frequency is almost twice as high as

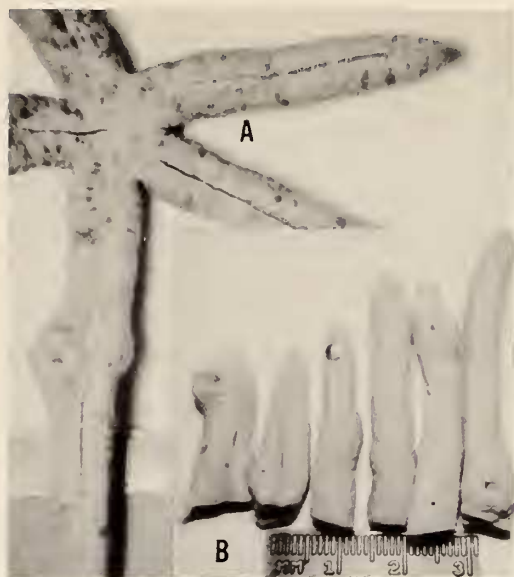


Figure 1



Figure 2

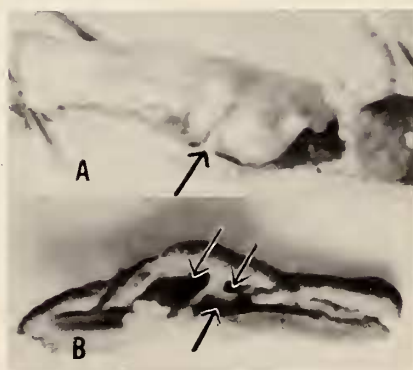


Figure 3

Figure 1 a: Oral view of *Linckia multifora*, showing the external appearance of the gall formed by *Styliifer linckiae*.

Figure 1 b: A series of parasitized rays from different individuals, selected to demonstrate the variability in size and location of the galls.

Figure 2: Partially dissected ray of *Linckia multifora*. The arrow indicates the layer of tissue separating *Styliifer linckiae* from the coelomic cavity of its host.

Figure 3 a: Partially dissected ray infected with two *Styliifer linckiae*. The arrow indicates the layer of host tissue separating the parasites.

Figure 3 b: Partially dissected ray which previously contained three *Styliifer linckiae*. The snails have been removed to show the distinct partitions which form three separate capsules.

